WHAT IS CLAIMED IS:

1. A system for detecting field ground, comprising:

a sense resistor;

an attenuator network;

a reference signal source providing a reference signal to field leads of an electrical machine, the reference signal operatively coupled with the sense resistor and an attenuator network, wherein the attenuator network is coupled to the field leads resulting in a signal that biases the center of the field plus and minus the reference signal with respect to ground;

a voltage controlled oscillator (VCO) adapted to measure differential voltage across the sense resistor; and

control logic adapted to coordinate the collection of measurement data, and extract an estimate of ground fault resistance and location of a ground fault from the measured data.

2. The system of claim 1, wherein the control logic includes a first communication channel for forwarding measurement commands for commanding the system to make measurements, and a second communication channel for reading measurements made by the system.

3. The system of claim 1, wherein the control logic is configured to estimate the ground fault resistance by performing measurements on two consecutive half cycles of the reference signal.

4. The system of claim 1, wherein the control logic is configured to estimate the ground fault resistance (Rx) using the equation:

Rx = {(2RRsRb^2+R^2Rb^2)((Vfgn/Vfgp)Vs1-Vs2) - 2RRsRb^2((Vfgn/Vfgp)*Voscp-Voscn)}/{(2RbR^2 +4RRbRs+2RRb^2)(Vs2-(Vfgn/Vfgp)Vs1) +4RRbRs((Vfgn/Vfgp)*Voscp-Voscn)},

where R represents an attenuator network coupled intermediate the reference signal and the field leads of the generator, Rb represents the resistance of bleed resistors, Vs1 and Vs2 represent, respectively, the voltage across the sense resistor Rs during the time the reference signal is on the positive and negative half cycles, Voscp and Voscn represent, respectively, the reference signal voltage on the positive and negative half cycles, and Vfgn and Vfgp represent, respectively, the field voltage during the time the reference signal is on the negative and positive half cycles.

5. The system of claim 1, wherein the control logic is configured to estimate the location of a ground fault using at least one of the equations:

x = (Vs1*(RRb^2+2R^2RbRx+2RRb^2Rx+4RRbRsRx) – (2RRb^2Rs+4RRbRsRx)*Voscp +(RRsRb^2 )*Vfgp)/(2RRsRb^2 *Vfgp);

x = (Vs2*(RRb^2+2R^2RbRx+2RRb^2Rx+4RRbRsRx) – (2RRb^2Rs+4RRbRsRx)*Voscn +(RRsRb^2 )*Vfgn)/(2RRsRb^2 *Vfgn),

where R represents an attenuator network coupled intermediate the reference signal and the field leads of the generator, Rb represents the resistance of bleed resistors, Vs1 and Vs2 represent, respectively, the voltage across the sense resistor Rs during the time the reference signal is on the positive and negative half cycles, Voscp and Voscn represent, respectively, the reference signal voltage on the positive and negative half cycles, and Vfgn and Vfgp represent, respectively, the field voltage during the time the reference signal is on the negative and positive half cycles.

6. The system of claim 1, wherein the control logic is configured to detect an AC ground fault by measuring fundamental frequency voltages in the sense resistor.

7. The system of claim 6, wherein the control logic is configured to identify the fault as being an AC fault if the ground fault resistance is approximately 1500 ohms or less.

8. The system of claim 6, wherein the control logic is configured to make a measurement a prescribed interval of time after a command to transition to a next oscillator level is made.

9. The system of claim 1, wherein the system includes at least one of a redundant low frequency oscillator and voltage controlled oscillator.

10. The system of claim 1, wherein the control logic further includes diagnostic logic for automatically measuring differential voltage across the sense resistor with the oscillator set at a frequency which is higher than the normal operational frequency.

11. The system of claim 1, wherein the reference signal generator is a low frequency oscillator and the reference signal is a square wave.

12. The system of claim 1, wherein the electrical machine is a generator.

13. The system of claim 1, wherein the generator includes at least one of an excitation system and a regulator.

14. The system of claim 1, wherein the control logic is adapted to differentiate between AC and DC field ground faults.

15. In a control system for operating an electrical machine, a method for detecting and measuring a field ground fault, the method comprising:

sensing the resistance of a sense resistor;

applying a reference signal to field leads of the generator through the sense resistor and attenuator network, wherein the attenuator network is coupled to both

field leads resulting in a signal that biases the center of the field within a range of plus and minus the reference signal with respect to ground;

measuring the differential voltage across the sense resistor;

analyzing the collected measurement data; and

detecting a ground fault and estimating ground fault resistance and location of a ground fault from the measured data.

16. The method of claim 15 comprising the further step of generating and forwarding measurement commands for commanding the system to make and read measurements for ground fault detection.

17. The method of claim 15 further comprising the step of performing measurements on two consecutive half cycles of the reference signal and estimating the ground fault resistance from such half cycle measurements.

18. The method of claim 15 comprising the further step of estimating the ground fault resistance (Rx) using the equation:

x = (Vs1*(RRb^2+2R^2RbRx+2RRb^2Rx+4RRbRsRx) – (2RRb^2Rs+4RRbRsRx)*Voscp +(RRsRb^2 )*Vfgp)/(2RRsRb^2 *Vfgp);

x = (Vs2*(RRb^2+2R^2RbRx+2RRb^2Rx+4RRbRsRx) – (2RRb^2Rs+4RRbRsRx)*Voscn +(RRsRb^2 )*Vfgn)/(2RRsRb^2 *Vfgn),

where R represents an attenuator network coupled intermediate the reference signal and the field leads of the generator, Rb represents the resistance of bleed resistors, Vs1 and Vs2 represent, respectively, the voltage across the sense resistor Rs during the time the reference signal is on the positive and negative half cycles, Voscp and Voscn represent, respectively, the reference signal voltage on the positive and negative half cycles, and Vfgn and Vfgp represent, respectively, the field voltage during the time the reference signal is on the negative and positive half cycles.

19. The method of claim 15, wherein the step of estimating the location of a ground fault involves using at least one of the equations:

x = Vs1*(R^2Rb^2+2R^2RbRx+2RRb^2Rx+2RRB^2Rs+4RRbRsRx) – (2RRb^2Rs+4RRbRsRx)*Voscp +(RRsRb^2 )*Vfgp/(2RRsRb^2 *Vfgp);

x = Vs2*(R^2Rb^2+2R^2RbRx+2RRb^2Rx+2RRB^2Rs+4RRbRsRx) – (2RRb^2Rs+4RRbRsRx)*Voscn +(RRsRb^2 )*Vfgn/(2RRsRb^2 *Vfgn),

where R represents an attenuator network coupled intermediate the reference signal and the field leads of the generator, Rb represents the resistance of bleed resistors, Vs1 and Vs2 represent, respectively, the voltage across the sense resistor Rs during the time the reference signal is on the positive and negative half cycles, Voscp and Voscn represent, respectively, the reference signal voltage on the positive and negative half cycles, and Vfgn and Vfgp represent, respectively, the field voltage during the time the reference signal is on the negative and positive half cycles.

20. The method of claim 15 further comprising the step of detecting an AC ground fault by measuring fundamental frequency voltages in the sense resistor.

21. The method of claim 20, wherein an AC fault is detected if the ground fault resistance is approximately 1500 ohms or less.